THE EARTH TRANSFORMED

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An Untold History

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Introduction

> Three things exercise a constant influence over the minds of men: climate, government and religion.
>
> Voltaire, *Essai sur les mœurs et l'esprit des nations* (1756)

'Man's first disobedience', wrote John Milton at the start of *Paradise Lost*, was to eat the fruit 'of that forbidden tree' in the Garden of Eden. The decision 'brought death into the World, and all our woe'. The loss of paradise turned the earth from a place of beauty and plenty into one of sorrow and sadness, where 'peace and rest can never dwell, hope never come' and where life was turned into 'torture without end'.[1]

Milton's epic poem, first published in the second half of the seventeenth century, was a retelling of the story that appears at the start of the Book of Genesis explaining how humans came to be the architects of their own demise. By allowing themselves to be tempted by the 'infernal Serpent', Adam and Eve condemned all future generations to lives of ecological challenge, ones where the environment was no longer always benign, where food was not always easy to come by and where humans had to work, rather than receive benefits from God. Paradise had been lost.

In today's world, the ways that our species works the land, exploits natural resources and treats sustainability are topics of vehement discussion – not least since many believe human activities to be so extensive and so damaging that they are changing the climate. This book sets out to look at how our planet, our enclosed garden (the literal meaning of the word 'paradise'), has changed since the beginning of

time, sometimes as a result of human endeavours, calculation and miscalculation, but also thanks to a host of other actors, factors, influences and impulses that have shaped the world we live in – often in ways we do not think about or understand. This book will explain how our world has always been one of transformation, transition and change because, outside the Garden of Eden, time does not stand still.

My first encounter with the human impact on the environment and climate change came with a children's current affairs programme called *John Craven's Newsround* which was shown every day in the UK when I was a young boy. *Newsround* was a flagship BBC project that was a lifeline, connecting younger viewers to the world beyond the British Isles. One of the few programmes my parents allowed my siblings and me to watch when we were growing up, it introduced me to the suffering of people at the hands of the Khmer Rouge, to the complexities of the Middle East and to the realities of the Cold War.

One of the themes that came up regularly in the late 1970s and early 1980s was the subject of acid rain. I remember being transfixed by the horror of trees without leaves and by the thought that human activity was responsible for the degradation of nature. The idea that the factories belched emissions that devastated forests, killed animals and contaminated the ground came as a shock to me. Even as a young boy, it seemed obvious that the choices we made to produce goods and products had impacts that had long-term effects on us all.

These misgivings were compounded by a fear of devastation that was a hallmark of my childhood. I am part of a generation that was brought up to believe that the world might see global nuclear war between the United States and the Soviet Union that would result in large-scale death not only from the detonation of countless intercontinental ballistic missiles (ICBMs) but from the nuclear winter that would result from mushroom clouds released by warheads on impact. One film, *When the Wind Blows*, which came out in the mid-1980s, painted a poignant and awful picture of what lay ahead: sadness, suffering, hunger and death – all because of humanity's ability to invent weapons of mass destruction that would not only kill millions through firestorms and explosions, but would change the earth's climate so drastically that survival alone would be a miracle.

The detonation of scores of nuclear weapons promised to throw so much debris into the atmosphere that we would have to learn to live

in sub-zero temperatures. Sunlight would be blocked by blankets of dust and particles with the result that plants would die. Animals would succumb as a result too – leaving those who survived the blasts not only freezing cold but hungry. Fallout from radiation would contaminate flora and fauna, poisoning all forms of life. The aim was to get through the apocalypse and to hope to be one of the survivors. In due course, we hoped, the climate would reset. Then it would be a case of seeing how many people were left alive and where, and starting again.

The fears of my generation were swelled by disaster, the most dramatic of which was the explosion in 1986 of the reactor at Chernobyl in what is now Ukraine. The reports of the catastrophic failure – strenuously denied for days by the Soviet authorities – were a reminder that miscalculations, misjudgements and incompetence could affect the world we lived in. In the months that followed, I studied maps of the fallout, was careful about what I ate and became acutely aware of the dangers posed by the potential for climatic change.

We used to spend our summers by a lake in the middle of Sweden. We said that we would flee there if there was ever a chance of a nuclear war breaking out. As most people know, Sweden is not the warmest country in the winter as it is; but I was reassured by the idea that being out of the way of soldiers, tanks and missiles would be a benefit. I was also comforted by the knowledge that blueberries (still my favourite fruit) were resilient to the cold. So I had a little bag packed by the side of my bed that I would update each year with my necessities for when (not if) changes to the world's climate would demand adaptation: a bar of chocolate; a Swiss Army penknife so I could make bows and arrows; some woollen gloves; a deck of cards and three balls; two pens (in case one ran out of ink); and some paper.

As it happened, my preparations were never needed – although it turns out that this was often because of luck rather than skill. As we now know, missile launches almost took place because of bears breaking down wire fences in search of food; because of misunderstandings about military exercises that made one side believe an attack was imminent; and because of weather balloons being misidentified as ballistic weapons systems. I grew up in a world of close shaves, near disasters and human error.

To be sure, there were many other things that scared me growing up: the 1970s and 1980s were a time of injustice, hatred, instability,

terrorism, famine and genocide. But ecological devastation, climate and climate change were constantly in the background as current problems that would get worse in the future. Few things were certain for my generation. One thing was clear: we were all but guaranteed to live on a planet that was more hostile, more unstable and more dangerous than the one we had grown up in. I assumed that that would be because of the catastrophe of global war or large-scale accidents.

It did not cross my mind that the end of the Cold War would lead to an age of ecologies being placed under ever greater stress, or that increased global economic co-operation would result in massive rises in levels of carbon emissions and a warming world. I was brought up to believe that disaster stemmed from the horrors of war; after all, that was what I was taught in the classroom. Peace and harmony, on the other hand, were supposed to be the solution – not part of the problem. And so, a journey that began many years ago watching *Newsround* has led me to think about human interventions in the landscape, about how the climate might have changed in the past, and above all about the role that climate has played in shaping the history of the world.

We live in a world teetering on the brink of disaster because of climate change. 'Every week brings new climate-related devastation,' said António Guterres, Secretary General of the United Nations in 2019. 'Floods. Drought. Heat waves. Wildfires. Superstorms.' This was no apocalyptic prediction, he said, for 'climate disruption is happening now, and it is happening to all of us'. As to what the future has in store, he went on, there is little hope. Lying in wait is nothing less than 'catastrophe for life as we know it'.[2]

There are many problems facing humanity, said Barack Obama in his penultimate address as President of the United States of America; 'and no challenge – no challenge – poses a greater threat to future generations than climate change'.[3] 'Today's ecological crisis, especially climate change,' said Pope Francis in 2019, 'threatens the very future of the human family.' The situation looks bleak. 'Future generations stand to inherit a greatly spoiled world,' he added. 'Our children and grandchildren should not have to pay the cost of our generation's irresponsibility.'[4]

Agreements reached by governments to deal with carbon emissions and global warming represent 'the minimum steps to be taken to protect

the Earth, our shared homeland', noted President Xi of the People's Republic of China in 2020. 'Humankind can no longer afford to ignore the repeated warnings of nature.' It is vital, therefore, to 'launch a green revolution and move faster to create a green way of development and life, preserve the environment and make Mother Earth a better place for all'.[5]

Others have put the threat personally as well as forcefully. 'You have stolen my dreams and my childhood with your empty words. And yet I'm one of the lucky ones,' said Greta Thunberg at the UN Climate Action Summit in September 2019. 'People are suffering. People are dying. Entire ecosystems are collapsing. We are in the beginning of a mass extinction, and all you can talk about is money and fairy tales of eternal economic growth. How dare you!'[6]

If climate change is going to be – or already is – the theme that will dominate the twenty-first century, sparking water shortages, famines, large-scale migrations, military conflict and mass extinction, then understanding what the future holds should be essential not just for politicians, scientists and activists, but for everyone. As a historian, I know that the best way to address complex problems is to look back in time, as this helps provide context and perspective for current and future challenges. And history can also teach valuable lessons that help formulate questions and sometimes even answers relating to some of the big issues that lie ahead of us.

This is particularly true when it comes to the relationship between human activities, the environment and the natural world in the regions and places that I have spent decades researching. In many if not all, availability and use of water, the expansion of food production and the geographic challenges and opportunities of local as well as long-distance trade are not just important factors but fundamental elements that underpin the broad sweep of history. As Fernand Braudel put it, the study of the past does not just involve the competition between humans and nature; it *is* the competition between humans and nature.[7]

When I first studied the Sasanian and ʿAbbāsid empires, I quickly learned that the success and stability of the state were closely linked to the irrigation of fields that enabled a rise in agricultural yields and supported larger populations.[8] Looking at the histories of China led me to research which argues that the rises, falls and replacement of imperial dynasties stretching back more than a millennium are closely correlated

with changes in temperature, with colder phases serving as periods of demographic decline, conflict and the replacement of imperial rulers with new regimes.[9]

Likewise, reading poetry such as *Meghadūtam* ('The Cloud Messenger') by the famous fifth-century Sanskrit poet Kālidāsa made clear how the monsoons and the rains, as well as the seasons, play a fundamental role in the literature, culture and histories of South Asia.[10] I learned long ago too that in the more recent past, Soviet policy in Central Asia in the 1950s was not only environmentally disastrous but had a significant impact on the Cold War and plays a role in the use of coerced labour in the region today.[11] I also know from experience how pollution in places I visit regularly is acrid, damaging and dangerous – with cities like New Delhi, Bishkek and Lahore ranked among the worst in the world for air quality. In Tashkent, the capital of Uzbekistan, the air was classified as dangerous 80 per cent of the time in the course of 2020.[12]

So I have set out to examine environmental history and to understand more clearly what the past tells us about human behaviour, about anthropogenic change in the natural world and about how extreme weather events, long-term weather patterns and climatic change have influenced and impacted history. I have wanted to assess why we seem to have arrived at the edge of a precipice where the future of our species – as well as those of a significant part of the animal and plant worlds – is at risk. Rather as a doctor should have full knowledge of an illness before trying to devise a cure, so too is investigating the causes of the current problems essential if we are to suggest a way to deal with the crises now confronting us all.

Historians are living in something of a golden age thanks to a rash of new evidence and new types of materials that help improve understanding of the past. Machine learning, computer models and data analysis are not just providing new lenses to look at other periods in history but revealing a plethora of information that was unknown and unseen. For example, networks of villages in the Amazon rainforest dating back many centuries and which were set out to mirror the cosmos have been identified thanks to Light Detection and Ranging (LIDAR) technology.[13] Advances in cost-effective laboratory visible-near infrared/shortwave infrared spectroscopy data have enabled groundbreaking work to reach conclusions about the social change in the Mapungubwe

landscape at the confluence of the Shashi and Limpopo rivers during the twelfth century.[14] Isotope data from human burials and from pig teeth in what is now Papua New Guinea help shed light not only on settlement patterns but on proportions of marine foods that people were eating more than 2,000 years ago.[15] And new technology has helped identify the mineralisation process of seeds preserved in refuse pits and cesspits in ʿAbbāsid-era Jerusalem, providing support for hypotheses about the westward diffusion of crops in the early Islamic period.[16]

Some of the most exciting advances have come in the way we understand the climate. These include inventive ways of using written sources that have been ignored or poorly utilised in the past. For example, clam shells from the coast of Peru enable climate reconstructions through changes in the chemistry of shells that allow researchers to identify yearly, monthly and even weekly ocean temperatures.[17] Records of cherry blossom festivals in Japan that go back to the start of the ninth century and note the date of the flowering of cherry trees help establish when spring arrived each year over the course of many centuries.[18] Registers kept by the harbour authorities in Tallinn in Estonia covering the last 500 years show the arrivals of the first ships each year, and consequently not only reveal when the sea became ice-free, but indicate patterns in longer and warmer springs.[19] Driftwood from the Svalbard archipelago in the Arctic shows considerable variability of sea ice between 1600 and 1850 which in turn points to unusual climatic patterns in this period.[20]

Above all, new and exciting 'climate archives' are being added to all the time. Many will feature in this book. We will consider information from growth rings in trees from the Altai mountains in Central Asia and from the build-up of mineral deposits from caves in Spain that show changes in temperature and rainfall; we will look at air bubbles trapped in ice cores in Greenland and in glaciers in the European Alps that provide evidence of volcanic eruptions as well as of human activities such as metallurgy and the burning of crops, forests or fossil fuels; we will encounter fossilised pollen from Oman and pollen deposits in lake valves in Anatolia that provide insights into changes of vegetation, both through natural causes and because of human intervention; we will come across carbonised and desiccated seeds in South-East Asia, dried nutshells from northern Australia and digested and partly digested foods from Palestine that provide evidence of diets as well as

disease. We will look at climate conditions conducive to the spread of parasitic pathogens in the Americas and at evidence for crop cycles in West Africa – as well as at phylogenetic trees of plague in Ethiopia, Kyrgyzstan and Cambridgeshire.

Many new sources of climate data are becoming available that allow us better to understand the natural world deep into the past. For example, a team of researchers are working on an eighty-metre-deep sedimentary layer in south-east Kazakhstan that provides a record of soil moisture – as well as offering insights into the role that Central Asia plays in global climate evolution in general and into the land–atmosphere–ocean water cycle in the northern hemisphere in particular. This is of considerable significance not only for studies of the past but also for future long-term global climate analysis.[21] So too is new research on the Tibetan plateau, where modelling based on findings from high, treeless areas – which are home to far more species than mountain forests – suggests a major decrease in plant diversity in alpine habitats in the coming centuries.[22]

Such new sources of evidence have led to revolutionary new ideas being developed about the past. New climate data provides insights into a tumultuous period in the middle of the third century in the Roman empire, with some scholars seeking to link reduced levels of solar activity, increases of sea ice and several major volcanic eruptions with rapid cooling, disrupted food production and a series of political, military and monetary crises precisely in this period.[23] Data about the persecution of Jews in Europe drawn from almost a thousand cities between 1100 and 1800 shows that a decrease in the average growing-season temperature of about one-third of 1 degree Celsius is correlated with a rise in the probability of Jews being attacked in the subsequent five-year period – with those living in and near locations with poor soil quality and weaker institutions more likely still to be the victims of violence during times of food shortages and higher prices.[24]

And a comparison of cold temperatures and wheat prices in Europe has led to new models being proposed about which cities were more resilient than others to price shocks; this has in turn spurred hypotheses that cooler weather in England in the early modern period led to agricultural revolution, which in turn prompted and rewarded the development of new technologies that led to an energy transition and ultimately gave rise to an age of European global empires.[25]

Not surprisingly, eye-catching arguments like these are a matter of lively discussion and sometimes heated debate among historians, with particular concerns voiced about historical and environmental determinism and about the problems of distinguishing between correlation and causation.[26] There are other challenges of interpretation. A case in point comes from the Indian subcontinent, a region that is ecologically and culturally diverse and home to a wide array of 'settled villages, hunter-gatherers, swidden cultivators, nomadic pastoralists and fisherfolk', as well as possessing astonishing species diversity and great climatic and ecological variety; as such, some scholars argue not only that are there dangers in making generalisations about the subcontinent as a whole, but that comparisons with other parts of the world are simply not appropriate.[27]

Another related issue is that those who write about climate and its impact often focus heavily on societal collapse, usually with a narrow band of signature examples – most notably the Maya, Easter Island and the 'fall' of the Roman empire – which have all been attributed to climate change in recent bestselling books.[28] Apart from the problems of oversimplifying complex narratives into narrow explanations (which authors are sometimes at pains to note), some believe that the urge to impart lessons – about the exhaustion of natural resources, about the failures to adapt to changing environmental conditions and to the consequences of not living sustainably – is a case of the tail wagging the dog, which is to say viewing the past through the prism of contemporary concerns.[29]

Much depends therefore on lightness of touch when dealing with new kinds of materials – just as good history requires sound judgement when dealing with written sources and with material culture. The problem then is not that climate science, data or new approaches are themselves flawed or misleading; rather they need to be handled carefully and put in contexts that are balanced, persuasive and appropriate.[30]

By and large, the weather, climate and environmental factors have rarely been seen as a backdrop to human history, let alone as an important lens through which to view the past. There are a handful of cases where climate features prominently, though usually not always plausibly. The famous story of King Xerxes ordering the waters of the Hellespont to be given 300 lashes after a storm brought down bridges that slowed his invasion of Greece in 480 BC would seem to be an apocryphal tale told

to highlight the illogical rage of a barbaric, tyrannical ruler rather than a reliable statement of fact.[31]

That two attacks ordered by Kublai Khan, the grandson of the great Činggis (or Genghis) Khan, on Japan in the late thirteenth century were thwarted by 'divine winds' or 'kamikaze', sent by the gods to frustrate the invaders, says more about how these events came to be seen in Japanese history than about the reason for the failure of Yuan dynasty which controlled most of what is now China to conquer Japan.[32] Most celebrated of all, though, is the onset of a hard Russian winter, which in popular imagination played a decisive role both in derailing Napoleon's ill-fated attack on Moscow in 1812 and in grinding German forces to a standstill and then to disaster after Hitler's attack on the Soviet Union in 1941. Both popular tropes obscure the fact that overambitious objectives, inefficient supply lines, poor strategic decisions and worse execution of plans on the ground were what doomed both invasions as much as, if not more than, the snow.[33]

In the main, though, we ignore climate and long-run climate patterns or changes altogether when we look at history. Most people can name the great leaders and major battles in the past, but few can name the biggest storms, the most significant floods, the worst winters, the most severe droughts, or the ways that these influenced harvest failures, provoked political pressures or were catalysts in the spread of disease. Reintegrating human and natural history is not just a worthwhile exercise; it is fundamentally important if we are to understand the world around us properly.[34]

Assessing the role of weather, extreme events, long-run climate patterns and changes in climate requires a detailed understanding of how the global climate system and subsystems are connected. The earth's climate is shaped by several closely related factors. First is the global weather system, which is constantly modulating because of changing atmospheric conditions, ocean currents and ice-sheet behaviour, as well as because of geological and plate tectonics and oscillations in the flow of liquid iron in earth's outer core. The tilt of the planet's axis, the mild eccentricity of the earth's orbit around the sun and the uneven distribution of energy between the equator and the poles also affect weather and climate patterns – as do the interactions between all these factors.[35]